LANSCE
Los Alamos Neutron Science Center

Research Proposal for the use of Neutron Science Facilities

☐ **Fast Access** ☐ **Joint CINT Proposal**

Proposal Number: 20111540
Submission Number: S1537
Date Received: 03/09/11

Program Advisory Subcommittee: Defense-related Nuclear Science
Focus Area:

Flight Path/Instrument: 4FP90L / FIRE House
Estimated Beam Time (days): 45
Days Recommended: 0
Dates Desired:
Impossible Dates:

TITLE
Fission Time Projection Chamber development: Sample imaging

☐ Continuation of Proposal #:

☐ Ph.D Thesis for:

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RESEARCH AREA

- ☐ Biological and Life Science
- ☐ Chemistry
- ☐ National Security
- ☐ Earth Sciences
- ☐ Engineering
- ☐ Environmental Sciences
- ☒ Nuc. Physics/chemistry
- ☐ Astrophysics
- ☐ Few Body Physics
- ☐ Fund. Physics
- ☐ Elec. Device Testing
- ☐ Dosimetry/Med/Bio
- ☐ Earth/Space Sciences
- ☐ Materials Properties/Test
- ☐ Other:
- ☐ Mat'l Science (incl Cond Matter)
- ☐ Medical Applications
- ☐ Nuclear Physics
- ☐ Polymers
- ☐ Physics (Excl Condensed Matter)
- ☒ Instrument Development
- ☒ Neutron Physics
- ☒ Fission
- ☒ Reactions
- ☐ Spectroscopy
- ☐ Nuc. Accel. Reactor Eng.
- ☒ Def. Science/Weapons Physics
- ☐ Radiography
- ☐ Threat Reduction/Homeland Sec.
- ☐ Other:

FUNDING AGENCY

- ☐ DOE/BES
- ☐ DOE/OBER
- ☒ DOE/NNSA
- ☒ DOE/NE
- ☐ DOE/SC
- ☐ DOE/Other
- ☐ DOD
- ☐ NSF
- ☐ Industry
- ☐ NASA
- ☐ NIH
- ☐ Foreign:
- ☐ Other US Gov't:
- ☐ Other:

PUBLICATIONS

Publications:

NONE

Abstract: S1537_TPCproposal3.pdf

By electronic submission, the Principal Investigator certifies that this information is correct to the best of their knowledge.

Safety and Feasibility Review *(to be completed by LANSCE Instrument Scientist/Responsible)*

☐ **No further safety review required** ☐ **To be reviewed by Experiment Safety Committee**

☐ **Approved by Experiment Safety Committee, Date:**

Recommended # of days:	**Change PAC Subcommittee and/or Focus Area to:**	**Change Instrument to:**

Comments for PAC to consider:

Instrument scientist signature: **Date:**

Printed 4:41 PM, April 5, 2011

Fission Time Projection Chamber development
- Sample imaging

The Pu-239 fission cross section needs to be known with very high accuracy for certain nuclear applications, and specifically to about 1% in the neutron energy range from 100 keV to 20 MeV for defense applications. Conventional methods for measuring fission cross sections are limited to 3-5%, and are thus insufficient for meeting the target accuracy. A Time Projection Chamber (TPC) for high precision fission cross sections is currently being developed in collaboration between four national laboratories and six universities to address this nuclear data need.

A prototype of the fission TPC was first tested in a neutron beam during the 2010 LANSCE run cycle, and was shown to meet all performance requirements. A picture of the detector installed on the 4FP90L flight path is shown in Fig. 1. The detector was operated both with a blank target and with a U-238 sample, and particle tracks were observed both from light charged-particles and fission fragments.

An important feature of the TPC is the ability to generate 3D pictures of particle tracks in the active volume of the detector. Particle tracking provide the capability to measure many of the systematic effects in fission cross section measurements that otherwise are estimated. Having this capability reduces the systematic uncertainties normally associated with cross section measurements, and will push the limit on the accuracy that can be achieved. We are requesting beam time to characterize the TPC's ability to image patterns on samples loaded in the detector.

The sample for this measurement consists of a carbon backing with a U-238 deposits with a well defined pattern (Fig. 3). The sample will be placed in on the central cathode plane of the TPC, and detector then placed in beam on 4PF90L. The number of neutron-induced fission events will be counted by registering the heavy-ion tracks created in the gas volume of the detector. The pattern on the sample will recreated in the data analysis to characterize the pointing resolution of the instrument.

Beam time request: 6 weeks of beam time is requested to complete the measurement. The beam time requested is guided by the statistical accuracy required to complete the analysis.

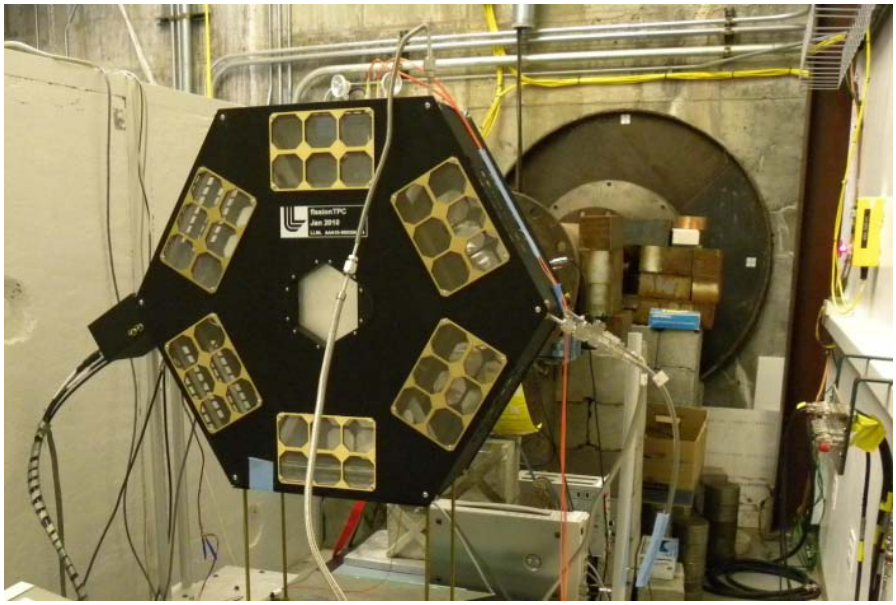

Fig. 1: The prototype fission TPC installed on 4FP90L during the 2010 LANSCE run cycle.

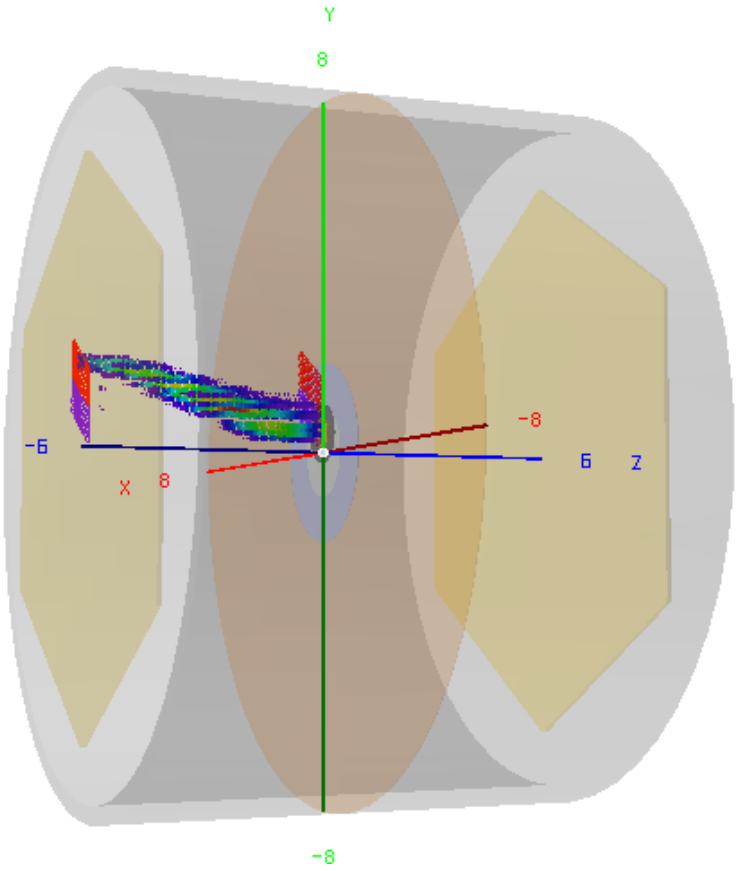

Fig. 2: Visualization of a neutron-induced fission fragment track collected with the fission TPC.

Fig. 3: TPC sample with U-238 deposit spelling out the letters NFT.